

Group Members: _____

The Shadowy Nature of Dot Products

We will be investigating the relationship between the projection of a vector and the angle that vector makes with another vector to help visualize the dot product of two vectors.

$$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}|\cos\theta$$

We will do this by measuring the projection (shadow) of a vector (straw) and comparing its length to the angle between the vector (straw) and the normal vector (ruler).

General Instructions:

When working with a known projection length, one member of the group will hold the straw at an unknown angle from the ruler until it produces the required projection length, another member will shine light straight down on top of the straw, and the third member will measure and record the shadow length.

When working from a known angle you will be given a protractor and: one member of the group will hold the straw at a known angle from the ruler, another member will shine light straight down on top of the straw, and the third member will measure and record the shadow length. You are not to measure the length of the straw.

You will perform this for the following angles and projection lengths:

Given the following projection (shadow) lengths:

1. $b_x = 18 \text{ cm}$, calculate $\theta = \underline{\hspace{2cm}}$
2. $b_x = 10 \text{ cm}$, calculate $\theta = \underline{\hspace{2cm}}$
3. $b_x = 2 \text{ cm}$, calculate $\theta = \underline{\hspace{2cm}}$
4. $b_x = -6 \text{ cm}$, calculate $\theta = \underline{\hspace{2cm}}$
5. $b_x = -14 \text{ cm}$, calculate $\theta = \underline{\hspace{2cm}}$

Given the following angles:

1. $\theta = 0^\circ$, $b_x = \underline{\hspace{2cm}}$ calculate $\mathbf{a} \cdot \mathbf{b} = \underline{\hspace{2cm}}$
2. $\theta = 45^\circ$, $b_x = \underline{\hspace{2cm}}$ calculate $\mathbf{a} \cdot \mathbf{b} = \underline{\hspace{2cm}}$
3. $\theta = 90^\circ$, $b_x = \underline{\hspace{2cm}}$ calculate $\mathbf{a} \cdot \mathbf{b} = \underline{\hspace{2cm}}$
4. $\theta = 135^\circ$, $b_x = \underline{\hspace{2cm}}$ calculate $\mathbf{a} \cdot \mathbf{b} = \underline{\hspace{2cm}}$
5. $\theta = 180^\circ$, $b_x = \underline{\hspace{2cm}}$ calculate $\mathbf{a} \cdot \mathbf{b} = \underline{\hspace{2cm}}$

Show All Work